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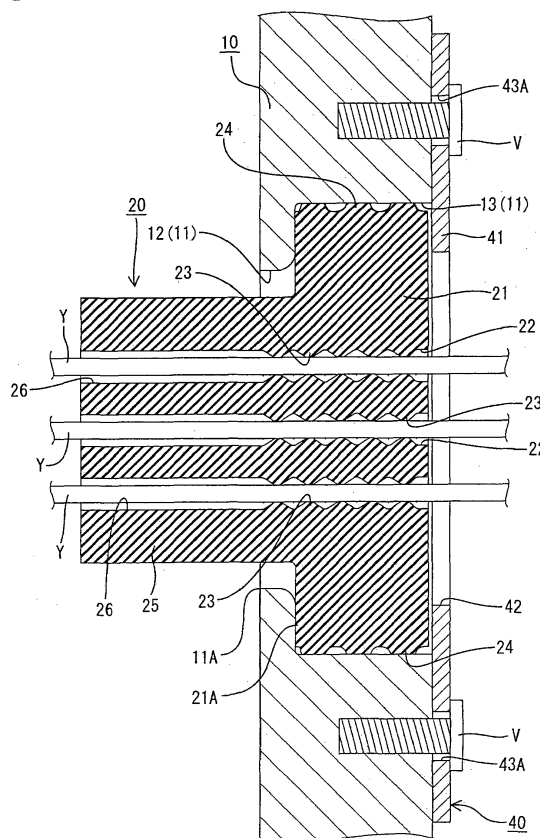
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(54) **Sealing structure for wire lead-out hole and sealing method therefor**

(57) A sealing structure for wire lead-out hole is provided with a wire lead-out hole (11) formed in a case (10), a resilient seal member (20) to be mounted into the wire lead-out hole (11), and a bracket (40) for retaining the resilient seal member (20) in the wire lead-out hole (11) by being fixed to the case (10). The resilient seal member includes a seal main body (21) including a plurality of wire insertion holes (22) for allowing insertion of wires (Y), outer lip portions (24) formed on the outer peripheral surface of the seal main body (21), inner lip portions (23) formed on the inner peripheral surfaces of the wire insertion holes (22), and a wire protecting portion (25) provided on the seal main body (21).

FIG. 4



Description

[0001] The present invention relates to a sealing structure for wire lead-out hole and to a sealing method therefor.

[0002] A wire clamp disclosed in Japanese Unexamined Patent Publication No. 2001-21066 is known as the one that is fixed to a wire lead-out hole of a case which protects an electronic device such as a control panel and adapted to hold a wire connected to the electronic device in the case. This wire clamp includes a clamp main body through which the wire is insertable, a nut for fixing the clamp main body to the case, a cap to be mounted on the leading end of the clamp main body and a resilient sleeve which is made of a resilient material and grips the wire by being pressed by the cap. Further, this wire clamp includes a sealing structure composed of a rubber packing for sealing between the wire inserted through the interior of the resilient sleeve and the resilient sleeve, a first O-ring for sealing between the clamp main body and the sleeve, a second O-ring for sealing between the clamp main body and the case, etc. to prevent entrance of dust, water and the like into the case.

[0003] However, in this type of the sealing structure for wire lead-out hole, the wire needs to be inserted through a plurality of parts such as the clamp main body, the resilient sleeve and the respective sealing members (rubber packing, O-rings) when the wire is mounted into the wire lead-out hole, and assembling operability is poor. If there is an error in an inserting order of the wire through the respective parts or it is forgotten to insert the wire through some of the parts, it is necessary to remove the respective parts from the wire and insert the wire again. Thus, working efficiency becomes very poor. Since the wire clamp of this type uses a plurality of parts with complicated structures, there is a problem of increasing cost.

[0004] The present invention was developed in view of the above situation and an object thereof is to allow a simple sealing of a wire lead-out hole.

[0005] This object is solved according to the invention by the features of the independent claims. Particular embodiments are subject of the dependent claims. Accordingly, the sealing structure for wire lead-out hole is simple in structure and can reduce the number of parts

[0006] According to the invention, there is provided a sealing structure for wire lead-out hole, comprising a wire lead-out hole formed in a case and substantially having a stepped configuration in which a large-diameter portion and a small-diameter portion are connected; a resilient seal member to be at least partly mounted into the wire lead-out hole; and a retaining or pressing member for retaining the resilient seal member in the wire lead-out hole by being fixed to the case; wherein the resilient seal member includes a seal main body including a wire insertion hole for allowing insertion of a wire; at least one outer lip portion formed on the outer peripheral surface of the seal main body and to be held in close contact with the inner peripheral surface of the large-diameter portion;

at least one inner lip portion formed on the inner peripheral surface of the wire insertion hole and to be held in close contact with the outer peripheral surface of the wire; and a wire protecting portion projecting from one end surface of the seal main body and to be provided between the inner peripheral surface of the small-diameter portion and the outer peripheral surface of the wire.

[0007] According to the thus constructed sealing structure, entrance of fluid or a liquid such as water, or other elements such as dust and the like through a clearance between the wire and the case can be prevented and the wire protecting portion can prevent the wire from being damaged due to contact with an opening of a small-diameter portion of the wire lead-out hole. Further, by reducing the number of parts as compared with conventional products, it becomes possible to reduce troubles caused such as by man-hour required for insertion of the wire through the respective parts and a mounting error at the time of wire insertion, wherefore a burden on an operator can be reduced. Further, a reduction in the number of the parts can contribute to a cost reduction.

[0008] The present invention may be particularly embodied to have the following constructions.

[0009] The wire protecting portion may project outwardly of the wire lead-out hole from an opening of the wire lead-out hole. According to this construction, the contact of the wire with the opening of the wire lead-out hole can be reliably prevented.

[0010] The seal main body may include a plurality of wire insertion holes; and a plurality of wire insertion paths which communicate with the plurality of wire insertion holes may be formed in the wire protecting portion. According to this construction, the plurality of wires can be easily guided to the wire insertion holes and entanglement of the wires in the wire protecting portion can be prevented.

[0011] The wire protecting portion may be formed with a wire insertion recess which is open at an end surface opposite to the seal main body and with which all the wire insertion holes communicate.

[0012] To form a seal member including long and narrow holes continuous with wire insertion holes in a wire protecting portion by injection molding, it is necessary to prepare a mold including long and narrow shaft portions having a length which is the sum of the length of a seal main body and that of the wire protecting portion. However, according to this construction, the length of the shaft portions of the mold can be set at the length of the seal main body and strength of the shaft portions can be increased as compared with a mold including long and narrow shaft portions having a length equal to the sum of the length of the seal main body and that of the wire protecting portion. Further, a mold structure can be simplified, which is effective in suppressing mold cost. Further, since the interior of the wire insertion recess requires no material upon forming the resilient seal member, material cost can be reduced by the volume of the wire insertion recess.

[0013] A plurality of slits may be formed in the peripheral wall of the wire insertion recess from an opening of the wire insertion recess toward the seal main body. According to this construction, in the case of inserting the wire into the wire insertion path from the wire protecting portion, the wire can be inserted while the peripheral wall of the wire protecting portion is turned outwardly. Thus, operability in assembling the wire can be improved.

[0014] The retaining or pressing member may comprise a bracket including a retaining plate which includes an insertion hole for allowing insertion of the wire and can come into contact with an end surface of the seal main body.

[0015] The retaining or pressing member may comprise one or more, preferably a pair of mounting pieces which are located at end portions of the retaining plate and fix the retaining plate to the case.

[0016] The retaining or pressing member may be or may comprise a bracket including a retaining plate which includes an insertion hole for allowing insertion of the wire and can come into contact with an end surface of the seal main body and a pair of mounting pieces which are located at end portions of the retaining plate and fix the retaining plate to the case. According to this construction, the bracket for retaining the resilient seal member can be produced very easily and at low cost by punching a metal plate by a press.

[0017] The retaining plate may be formed with a wire insertion groove for allowing insertion of the wire between the outer peripheral surface of the retaining plate and the inner peripheral surface of the insertion hole. According to this construction, it is not necessary to insert the wire through the bracket beforehand, and the wire can be inserted into the insertion hole through the wire insertion groove and the bracket can be fixed to the case after the resilient seal member having the wire inserted there-through beforehand is mounted into the wire lead-out hole. Thus, assembling operability can be improved.

[0018] According to the invention, there is further provided a method of sealing a wire lead-out hole formed in a case and substantially having a stepped configuration in which a large-diameter portion and a small-diameter portion are connected, comprising the following steps:

inserting a wire into a wire insertion hole of a seal main body of a resilient seal member, wherein at least one inner lip portion formed on the inner peripheral surface of the wire insertion hole is brought into close contact with the outer peripheral surface of the wire;

at least partly mounting the resilient seal member into the wire lead-out hole, wherein:

at least one outer lip portion formed on the outer peripheral surface of the seal main body is brought into close contact with the inner peripheral surface of the large-diameter portion, and a wire protecting portion projecting from one end

surface of the seal main body is provided between the inner peripheral surface of the small-diameter portion and the outer peripheral surface of the wire; and

retaining the resilient seal member in the wire lead-out hole by means of a retaining or pressing member being fixed to the case.

[0019] The above method may be particularly embodied as follows:

[0020] The wire protecting portion may be arranged such as to project outwardly of the wire lead-out hole from an opening of the wire lead-out hole.

[0021] The seal main body may include a plurality of wire insertion holes; and a plurality of wire insertion paths which communicate with the plurality of wire insertion holes may be formed in the wire protecting portion.

[0022] The wire protecting portion may be formed with a wire insertion recess which is open at an end surface opposite to the seal main body and with which all the wire insertion holes communicate.

[0023] A plurality of slits may be formed in the peripheral wall of the wire insertion recess from an opening of the wire insertion recess toward the seal main body.

[0024] The sealing method may further comprise inserting the wire into an insertion hole of a retaining plate of the pressing member, wherein the pressing member is brought into contact with an end surface of the seal main body.

[0025] The sealing method may further comprise fixing the retaining or pressing member by means of one or more, preferably a pair of mounting pieces thereof which are located at end portions of the retaining plate and fix the retaining plate to the case.

[0026] According to the above, it is possible to provide a sealing structure which is simple in structure and can reduce the number of parts.

[0027] These and other objects, features and advantages of the present invention will become more apparent upon reading of the following detailed description of preferred embodiments and accompanying drawings. It should be understood that even though embodiments are separately described, single features thereof may be combined to additional embodiments.

FIG. 1 is a front view of a resilient seal member according to a first embodiment,

FIG. 2 is a rear view of the resilient seal member,

FIG. 3 is a section along III-III of FIG. 1,

FIG. 4 is a section showing a state where the resilient seal member and a bracket are mounted in and at a wire lead-out hole of a case,

FIG. 5 is a front view of a bracket including an O-shaped retaining plate,

FIG. 6 is a front view of a bracket including a C-shaped retaining plate,

FIG. 7 is a front view of a resilient seal member ac-

cording to a second embodiment,
 FIG. 8 is a section along VIII-VIII of FIG. 7,
 FIG. 9 is a front view of a resilient seal member according to a third embodiment, and
 FIG. 10 is a section along X-X of FIG. 9.

<First Embodiment>

[0028] A first particular embodiment of the present invention is described with reference to FIGS. 1 to 6.

[0029] A sealing structure for wire lead-out hole according to this embodiment is illustrated such that a resilient seal member 20 is to be at least partly inserted in a wire lead-out hole 11 formed in a case 10 which protects, for example, an electronic device such as a control panel and a bracket 40 is to be mounted to retain the resilient seal member 20 in the wire lead-out hole 11 as shown in FIG. 4.

[0030] The wire lead-out hole 11 is composed of or comprises a small-diameter portion 12 extending toward an inner side of the case 10 and a large-diameter portion 13 extending to an outer side of the case 10 and connected to the small-diameter portion 12 via a step as shown in FIG. 4. The large-diameter portion 13 is widened over the entire circumference as compared to the small-diameter portion 12, and an opening formed in an outer surface of the case 10 by the large-diameter portion 13 has a circular shape. Accordingly, the wire lead-out hole particularly substantially has a stepped-like configuration (see e.g. FIG. 4). The smaller-diameter portion 12 particularly has at least part of its inner edges being rounded (particularly along its complete circumference).

[0031] The resilient seal member 20 is, for example, made of a resilient material such as silicone or rubber and includes a (particularly substantially cylindrical) seal main body 21 as shown in FIGS. 1 to 3. The outer diameter of this seal main body 21 is set to be somewhat smaller than the inner diameter of the large-diameter portion 13 of the wire lead-out hole 11. Further, the thickness of the seal main body 21 particularly is set to be substantially equal to the length from the opening of the large-diameter portion 13 formed in the case 10 to the small-diameter portion 12. Accordingly, the seal main body 21 at least partly is or can be fitted and/or accommodated into the large-diameter portion 13 of the wire lead-out hole 11 as shown in FIG. 4.

[0032] One or more, particularly a plurality of (particularly looped or rounded or wiggled) outer lip portions 24 are formed on the outer peripheral surface of the seal main body 21. These outer lip portions 24 are to be held in close contact with the inner peripheral surface of the large-diameter portion 13 (particularly substantially over the entire circumference) to seal between the large-diameter portion 13 and the seal main body 21 in a fluid- or liquid-tight manner as shown in FIG. 4 when the seal main body 21 is at least partly accommodated in the large-diameter portion 13 of the wire lead-out hole 11.

[0033] One or more, particularly a plurality of wire in-

sertion holes 22 substantially extending in a thickness direction of the seal main body 21 is formed in the seal main body 21. One or more, particularly a plurality of inner lip portions 23 are formed on the inner peripheral surface of the (particularly each) wire insertion hole 22. These inner lip portions 23 are to be held in close contact with the outer peripheral surface of a wire Y to seal between the wire Y and the seal main body 21 in a fluid- or liquid-tight manner as shown in FIG. 4 when the wire Y is inserted into the wire insertion hole 22.

[0034] On the other hand, the bracket 40 is formed particularly by punching or cutting a plate material (such as a metal plate) by a press. As shown in FIG. 5, the bracket 40 includes a substantially ring- or O-shaped retaining plate 41 (particularly with a substantially circular shape), an insertion hole 42 formed in (or substantially around) the center of the retaining plate 41, and one or more mounting pieces 43 provided at (particularly substantially opposite and/or upper and lower end portions of) the retaining plate 41.

[0035] The outer diameter of the retaining plate 41 is set to be larger than the inner diameter of the large-diameter portion 13 of the wire lead-out hole 11.

[0036] The insertion hole 42 particularly substantially has a circular shape, and/or the inner diameter thereof is set to be smaller than the outer diameter of the seal main body 21 of the seal member 20. Thus, the retaining plate 41 closes the large-diameter portion 13 of the wire lead-out hole 11 to retain the resilient seal member 20 at least partly accommodated in the wire lead-out hole 11 as shown in FIG. 4 when the bracket 40 is fixed to the housing 10.

[0037] The inner diameter of the insertion hole 42 is set such that all the wire insertion holes 22 in the seal main body 21 at least partly are accommodated inside the insertion hole 42. Thus, one or more, particularly a plurality of wires Y drawn out from the wire insertion holes 22 of the seal main body 21 are or can be collectively inserted through the insertion hole 42 as shown in FIG. 4.

[0038] A bolt insertion hole 43A is formed in (particularly a substantially central part of) each mounting piece 43. As shown in FIG. 4, the bracket 40 is or can be fixed to the case 10 by at least partly inserting tightening bolts V (or mounting plugs) into the bolt insertion holes 43A and tightening or fixing them into the case 10. Note that the bracket 40 may have a C shape by cutting off a part of the retaining plate 41 to form a wire insertion groove 44 as shown in FIG. 6. By this, the bracket 40 can be fixed to the case 10 by inserting the wires Y into the insertion hole 42 through the wire insertion groove 44 after the seal member 20 having the wires Y inserted there-through beforehand is mounted into the wire lead-out hole 11 without inserting the wires Y through the bracket 40 beforehand.

[0039] A wire protecting portion 25 integrally or unitarily formed to the seal main body 21 projects from an end surface 21A of the seal main body 21 of the resilient seal member 20.

[0040] The wire protecting portion 25 is in the form of a particularly substantially rectangular column with four rounded corners and is narrower than the seal main body 21 over the entire circumference as shown in FIGS. 1 and 3. It should be understood, however, that the wire protecting portion 25 may be in the form of a polygonal or cylindrical or elliptical shape. One or more, particularly a plurality of wire insertion paths 26 are formed in this wire protecting portion 25. The wire insertion paths 26 particularly are formed to have the substantially same diameter as the wire insertion holes 22 of the seal main body 21 and communicate with the wire insertion holes 22. In a specific embodiment, the wire insertion paths 26 may be formed to have a variable inner diameter (e.g. a substantially conical diameter) being decreasing along the longitudinal direction of the wire protecting portion 25 towards the wire insertion holes 22, wherein the diameter at the distal end of the wire insertion paths 26 is substantially equal to that of the wire insertion holes 22 so as to allow a smooth passage of the inserted wire from the wire insertion paths 26 to the wire insertion holes 22. A projecting distance of the wire protecting portion 25 from the seal main body 21 is set to be longer than the length of the small-diameter portion 12 (i.e. its thickness extension in a thickness direction or a direction normal to a plane of the case 10) of the wire lead-out hole 11 in an axial or longitudinal direction. Thus, when the resilient seal member 20 is inserted into the wire lead-out hole 11, a base end portion of the wire protecting portion 25 is arranged in the small-diameter portion 12 of the wire lead-out hole 11 and the remaining part projects toward the inner side of the case 10 from the small-diameter portion 12. Thus, the wire protecting portion 25 can prevent the wires Y drawn out from the wire lead-out hole 11 to the interior of the case 10 from coming into contact with the opening 11 A of the wire lead-out hole 11 A and from being damaged.

[0041] The first embodiment is constructed as described above. Next, an operation of mounting the resilient seal member 20 and the bracket 40 is briefly described.

[0042] First, the wires Y are inserted into the wire insertion paths 26 from the wire protecting portion 25 of the resilient seal member 20 and further into the wire insertion holes 22. In this process, since the wire protecting portion 25 is formed with the wire insertion paths 26 for substantially guiding the wires Y to the wire insertion holes 22, the wires Y can be easily guided to the wire insertion holes 22, wherefore operability in inserting the wires Y can be improved. Further, since the respective wire insertion paths 26 particularly are independent in the wire protecting portion 25, entanglement of a plurality of wires Y can be prevented.

[0043] Further, the inner lip portions 23 of the wire insertion holes 22 are to be held in close contact with the outer peripheral surfaces of the wires Y to seal between the wires Y and the resilient seal member 20 in a fluid- or liquid-tight manner.

[0044] Subsequently, the resilient seal member 20 having the wires Y inserted therethrough at least partly is fitted into the wire lead-out hole 11 from the outer side of the case 10 and inserted until the end surface 21 A of the seal main body 21 substantially comes into surface contact with a step surface as a boundary between the small-diameter portion 12 and the large-diameter portion 13 of the wire lead-out hole 11. At this time, since the wire protecting portion 25 projects into the case 10 through the opening of the small-diameter portion 12 of the wire lead-out hole 11, the wires Y can be prevented from coming into contact with the opening 11 A of the wire lead-out hole 11 and from being damaged. Further, the outer lip portions 24 of the seal main body 21 are held in close contact with the inner peripheral surface of the wire lead-out hole 11 to seal between the case 10 and the resilient seal member 20 in a fluid- or liquid-tight manner. Further, a pressure acts toward the center of the seal main body 21 by the close contact of the outer lip portions 24 with the inner peripheral surface of the wire lead-out hole 11 over the entire circumference, whereby the inner lip portions 23 are more closely held substantially in contact with the outer peripheral surfaces of the wires Y. Thus, entrance of dust, water and the like into the case 10 can be reliably prevented.

[0045] After the resilient seal member 20 is completely or properly inserted into the wire lead-out hole 11, the bracket 40 is pressed from the outer side of the wire lead-out hole 11 and the one or more tightening bolts V are tightened into the case 10, whereby the bracket 40 is fixed to the case 10 while retaining the resilient seal member 20.

[0046] As described above, in this embodiment, the contact of the wires Y with the opening 11 A of the wire lead-out hole 11 can be prevented and the number of the parts of the sealing structure in the wire lead-out hole 11 can be reduced to about half as compared with conventional products. Thus, an operation of inserting the wires Y through the respective parts beforehand is reduced to half and an assembling operation by an operator can be drastically improved. Further, since the number of parts through which the wires Y are inserted is reduced, troubles such as an error in an insertion order can also be prevented. In the case of providing the bracket 40 with the wire insertion groove 44, the wires Y need not be inserted through the bracket 40 beforehand. Troubles such as an error in an insertion order do not occur at all and a burden on the operator can be drastically reduced. Further, a reduction in the number of the parts can contribute to a cost reduction.

<Second Embodiment>

[0047] Next, a second particular embodiment of the present invention is described with reference to FIGS. 7 and 8. A sealing structure of the second embodiment differs from the first embodiment in the construction of the wire protecting portion 25 of the resilient seal member

20. The similar or substantially same constructions as in the first embodiment are identified by the same reference numerals. Further, the similar or substantially same constructions, functions and effects as in the first embodiment are not described.

[0048] A wire protecting portion 25 of a resilient seal member 20 in the second embodiment is formed with a wire insertion recess 27 in an end surface 25A (projecting surface of the wire protecting portion 25) substantially opposite to a seal main body 21 as shown in FIG. 8. Thus, the peripheral wall of the wire insertion recess 27 is set to have such a thickness as to be substantially resiliently deformable. All wire insertion holes 22 of the seal main body 21 are open in a back wall 27A of the wire insertion recess 27, and the wire insertion recess 27 and all the wire insertion holes 22 communicate.

[0049] According to this construction, particularly material cost can be reduced by the volume of the wire insertion recess 27 upon forming the resilient seal member 20. In order to form long and narrow holes (wire insertion paths 26 in the first embodiment) continuous with the wire insertion holes 22 in the wire protecting portion 25, a mold needs to be formed with long and narrow shaft portions having a length which is the sum of the length of the seal main body 21 and that of the wire protecting portion 25. However, by providing the wire protecting portion 25 with the wire insertion recess 27, the length of the shaft portions of the mold can be set at the length of the seal main body and strength of the shaft portions can be increased as compared with a mold including long and narrow shaft portions having a length equal to the sum of the length of the seal main body and that of the wire protecting portion. Further, a mold structure can be simplified as compared with a mold including shaft portions longer than the length of the seal main body 21, which is effective in suppressing mold cost.

<Third Embodiment>

[0050] Next, a third particular embodiment of the present invention is described with reference to FIGS. 9 and 10. A sealing structure of the third embodiment differs from the second embodiment in the construction of the wire protecting portion 25 of the resilient seal member 20. The similar or substantially same constructions as in the second embodiment are identified by the same reference numerals. Further, the similar or substantially same constructions, functions and effects as in the second embodiment are not described.

[0051] In a wire protecting portion 25 of the third embodiment, slits 28 are formed in the peripheral wall of the wire protecting portion 25 as shown in FIGS. 9 and 10. These slits 28 are formed at or near four corners of the wire protecting portion 25 and/or substantially extend straight from an opening of a wire insertion recess 27 toward a seal main body 21.

[0052] According to this construction, in the case of inserting wires into wire insertion holes 22 from the wire

insertion recess 27, an operator's hand can be inserted to the back of the wire insertion recess 27 by turning the peripheral wall of the wire protecting portion 25 outwardly. Thus, ends of wires Y can be more easily inserted into the wire insertion holes 22 and operability in mounting the wires Y can be improved.

[0053] Accordingly, to provide a sealing structure for wire lead-out hole which is simple in structure and can reduce the number of parts, a sealing structure for wire lead-out hole is provided with a wire lead-out hole 11 formed in a case 10, a resilient seal member 20 to be mounted into the wire lead-out hole 11, and a bracket 40 for retaining the resilient seal member 20 in the wire lead-out hole 11 by being fixed to the case 10. The resilient seal member includes a seal main body 21 including one or more, particularly a plurality of wire insertion holes 22 for allowing insertion of wires Y, one or more outer lip portions 24 formed on the outer peripheral surface of the seal main body 21, one or more inner lip portions 23 formed on the inner peripheral surfaces of the one or more wire insertion holes 22, and a wire protecting portion 25 provided on the seal main body 21.

<Other Embodiments>

[0054] The present invention is not limited to the above described and illustrated embodiments. For example, the following embodiments are also included in the technical scope of the present invention as defined by the claims.

(1) Although the length of the wire protecting portion 25 is longer (in an axial or longitudinal direction) than that of the small-diameter portion 12 of the wire lead-out hole 11 in the above embodiments, the present invention is not limited to such a mode. According to the present invention, the length of the wire protecting portion 25 may be, for example, set to be substantially equal to that of the small-diameter portion 12. The length of the wire protecting portion 25 may be so set that the wires Y inserted into the wire protecting portion 25 do not come into contact with the opening of the wire lead-out hole 11.

(2) Although the wire protecting portion 25 is in the form of a rectangular column with four rounded corners in the above embodiments, the present invention is not limited to such a mode and the wire protecting portion 25 may be, for example, in the form of a cylinder.

(3) Although the small-diameter portion 12 of the wire lead-out hole 11 is provided at the inner side of the case 10 and the large-diameter portion 13 is arranged at the outer side of the case 10, the present invention is not limited to such a mode. The small-diameter portion 12 of the wire lead-out hole 11 may be provided at the outer side of the case 10, the large-diameter portion 13 may be provided at the inner side of the case 10, and the seal member 40 20 may be retained by the bracket 40 from the inner

side of the case 10.

(4) Although the slits 28 are formed at or near the four corners of the peripheral wall of the wire protecting portion 25 in the third embodiment, the present invention is not limited to such a mode. For example, the number of slits may be increased or decreased according to the thickness of the peripheral wall of the wire protecting portion 25 to such an extent that the peripheral wall is not naturally deflected.

LIST OF REFERENCE NUMERALS

[0055]

10:	case
11:	wire lead-out hole
12:	small-diameter portion
13:	large-diameter portion
20:	resilient seal member
21:	seal main body
22:	wire insertion hole
23:	inner lip portion
24:	outer lip portion
25:	wire protecting portion
26:	wire insertion path
27:	wire insertion recess
28:	slit
40:	bracket (pressing member)
41:	retaining plate
42:	insertion hole
43:	mounting piece
44:	wire insertion groove
Y:	wire

Claims

1. A sealing structure for wire lead-out hole (11), comprising a wire lead-out hole (11) formed in a case

(10) and substantially having a stepped configuration in which a large-diameter portion (13) and a small-diameter portion (12) are connected; a resilient seal member (20) to be at least partly mounted into the wire lead-out hole (11); and a retaining or pressing member (40) for retaining the resilient seal member (20) in the wire lead-out hole (11) by being fixed to the case (10); wherein the resilient seal member (20) includes:

a seal main body (21) including a wire insertion hole (22) for allowing insertion of a wire (Y); at least one outer lip portion (24) formed on the outer peripheral surface of the seal main body (21) and to be held in close contact with the inner peripheral surface of the large-diameter portion (13); at least one inner lip portion (23) formed on the inner peripheral surface of the wire insertion hole (22) and to be held in close contact with the outer peripheral surface of the wire (Y); and a wire protecting portion (25) projecting from one end surface of the seal main body (21) and to be provided between the inner peripheral surface of the small-diameter portion (12) and the outer peripheral surface of the wire (Y).

2. A sealing structure according to claim 1, wherein the wire protecting portion (25) projects outwardly of the wire lead-out hole (11) from an opening of the wire lead-out hole (11).
3. A sealing structure according to any one of the preceding claims, wherein:

the seal main body (21) includes a plurality of wire insertion holes (22); and a plurality of wire insertion paths (26) which communicate with the plurality of wire insertion holes (22) are formed in the wire protecting portion (25).

4. A sealing structure according to any one of the preceding claims, wherein the wire protecting portion (25) is formed with a wire insertion recess (27) which is open at an end surface opposite to the seal main body (21) and with which all the wire insertion holes (22) communicate.

5. A sealing structure according to claim 4, wherein a plurality of slits (28) are formed in the peripheral wall of the wire insertion recess (27) from an opening of the wire insertion recess (27) toward the seal main body (21).

6. A sealing structure according to any one of the preceding claims, wherein the retaining or pressing member (40) comprises a bracket including a retain-

ing plate (41) which includes an insertion hole (42) for allowing insertion of the wire (Y) and can come into contact with an end surface of the seal main body (21).

7. A sealing structure according to claim 6, wherein the retaining or pressing member (40) comprises one or more, preferably a pair of mounting pieces (43) which are located at end portions of the retaining plate (41) and fix the retaining plate (41) to the case (10).

8. A sealing structure according to claim 6 or 7, wherein the retaining plate (41) is formed with a wire insertion groove (44) for allowing insertion of the wire (Y) between the outer peripheral surface of the retaining plate (41) and the inner peripheral surface of the insertion hole (42).

9. A method of sealing a wire lead-out hole (11) formed in a case (10) and substantially having a stepped configuration in which a large-diameter portion (13) and a small-diameter portion (12) are connected, comprising the following steps:

inserting a wire (Y) into a wire insertion hole (22) of a seal main body (21) of a resilient seal member (20), wherein at least one inner lip portion (23) formed on the inner peripheral surface of the wire insertion hole (22) is brought into close contact with the outer peripheral surface of the wire (Y);
at least partly mounting the resilient seal member (20) into the wire lead-out hole (11), wherein:

at least one outer lip portion (24) formed on the outer peripheral surface of the seal main body (21) is brought into close contact with the inner peripheral surface of the large-diameter portion (13), and
a wire protecting portion (25) projecting from one end surface of the seal main body (21) is provided between the inner peripheral surface of the small-diameter portion (12) and the outer peripheral surface of the wire (Y); and

retaining the resilient seal member (20) in the wire lead-out hole (11) by means of a retaining or pressing member (40) being fixed to the case (10).

10. A sealing method according to claim 9, wherein the wire protecting portion (25) is arranged such as to project outwardly of the wire lead-out hole (11) from an opening of the wire lead-out hole (11).

11. A sealing method according to claim 9 or 10, wherein the seal main body (21) includes a plurality of wire

insertion holes (22); and a plurality of wire insertion paths (26) which communicate with the plurality of wire insertion holes (22) are formed in the wire protecting portion (25).

12. A sealing method according to any one of the preceding claims 9 to 11, wherein the wire protecting portion (25) is formed with a wire insertion recess (27) which is open at an end surface opposite to the seal main body (21) and with which all the wire insertion holes (22) communicate.

13. A sealing method according to claim 12, wherein a plurality of slits (28) are formed in the peripheral wall of the wire insertion recess (27) from an opening of the wire insertion recess (27) toward the seal main body (21).

14. A sealing method according to any one of the preceding claims 9 to 13, further comprising inserting the wire (Y) into an insertion hole (42) of a retaining plate (41) of the pressing member (40), wherein the pressing member (40) is brought into contact with an end surface of the seal main body (21).

15. A sealing method according to claim 14, further comprising fixing the retaining or pressing member (40) by means of one or more, preferably a pair of mounting pieces (43) thereof which are located at end portions of the retaining plate (41) and fix the retaining plate (41) to the case (10).

FIG. 1

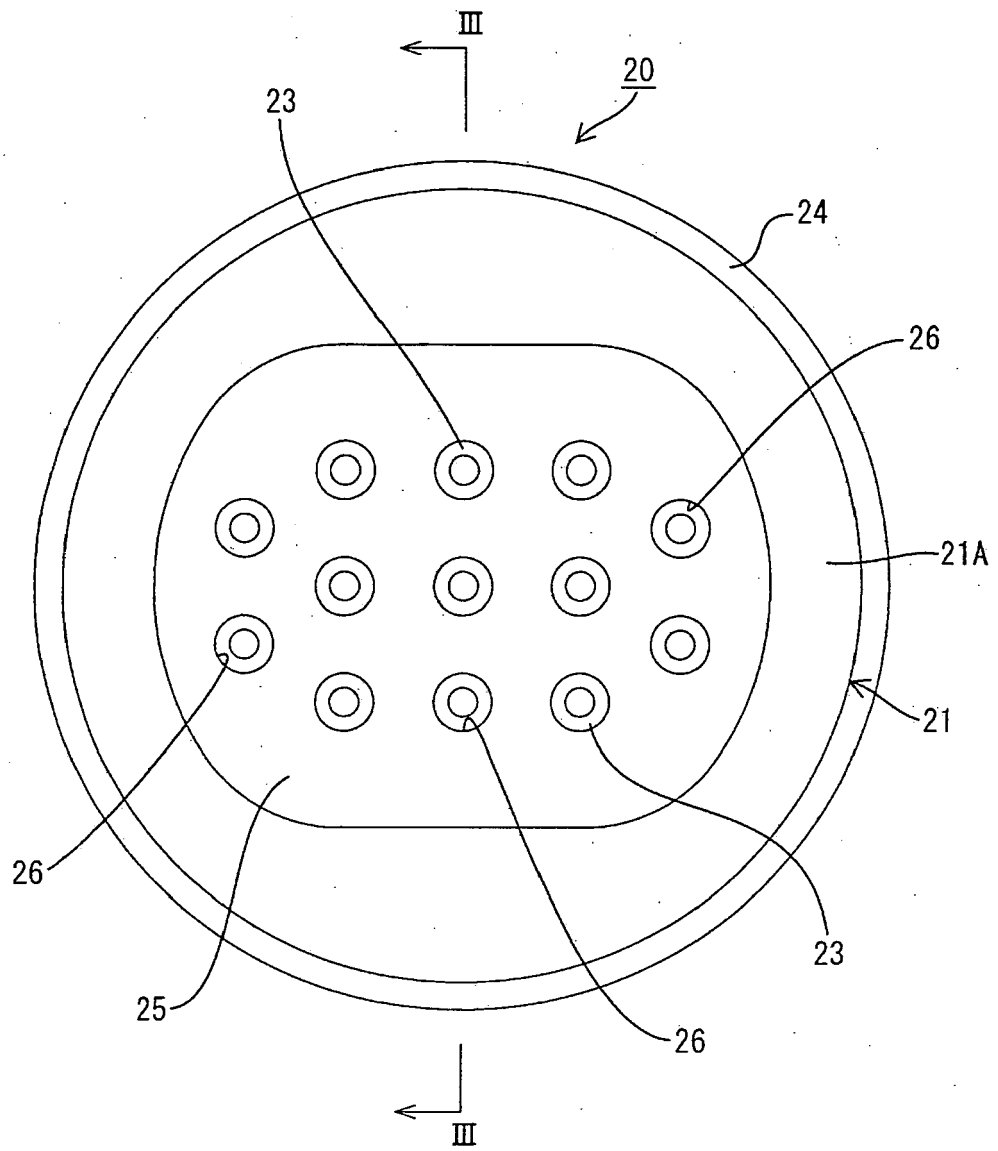


FIG. 2

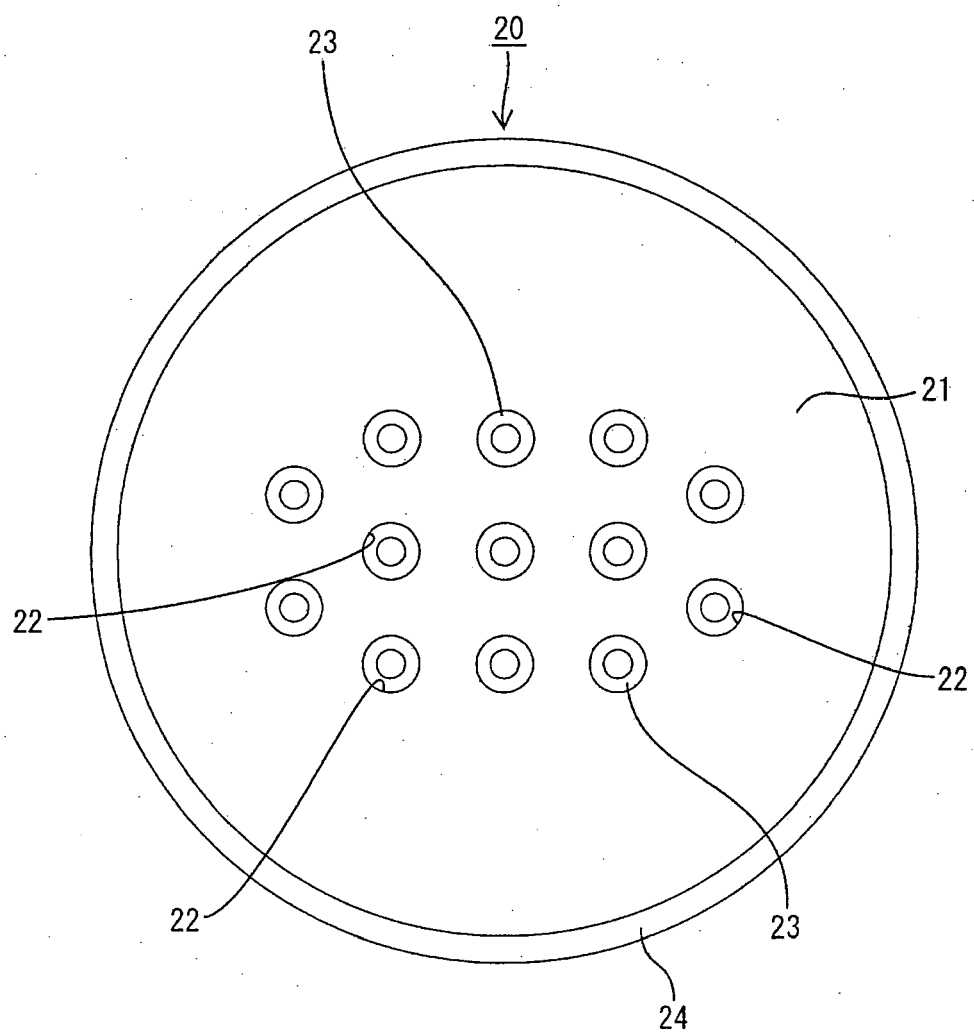


FIG. 3

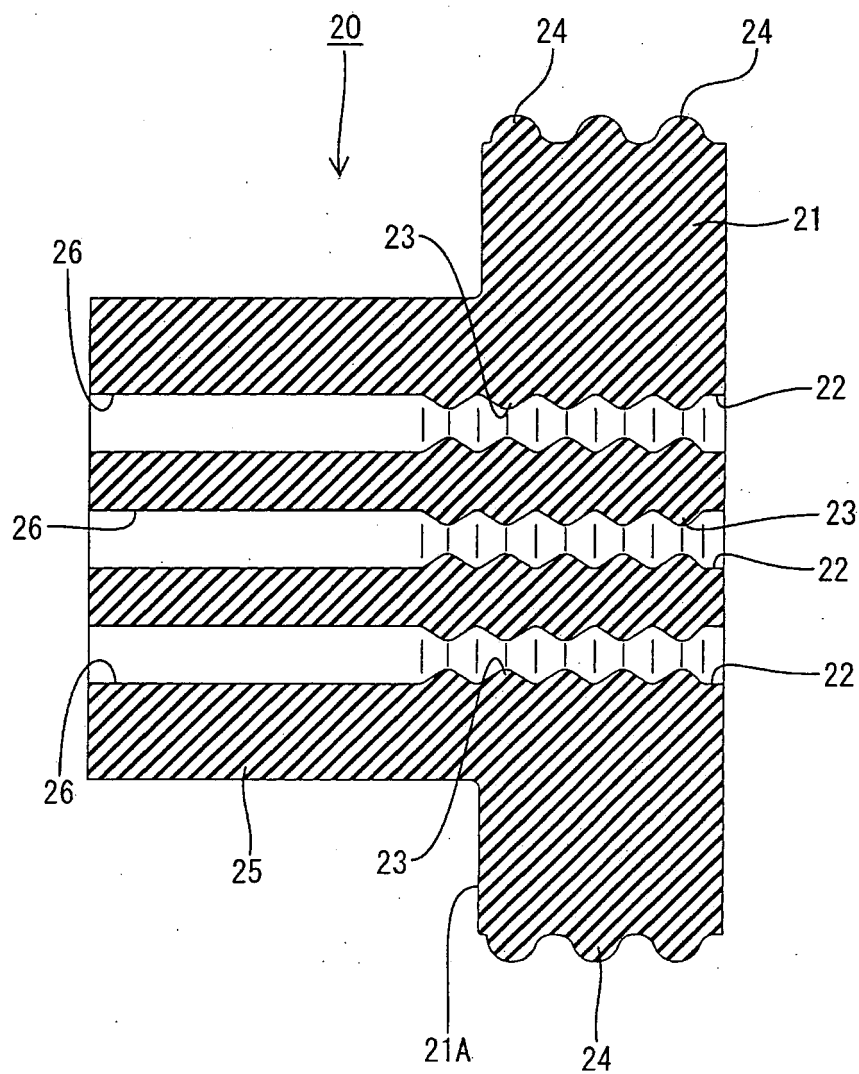


FIG. 4

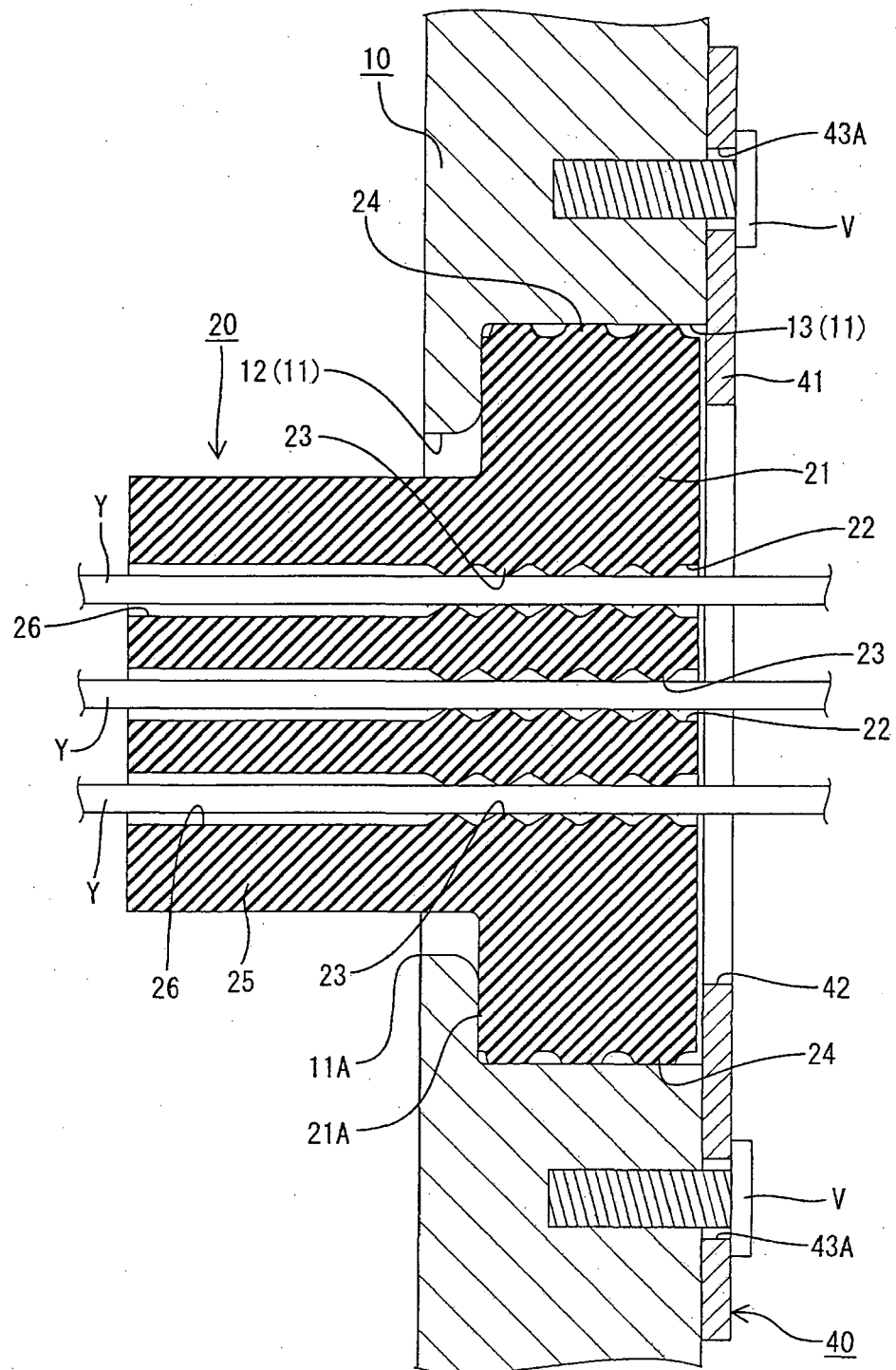


FIG. 5

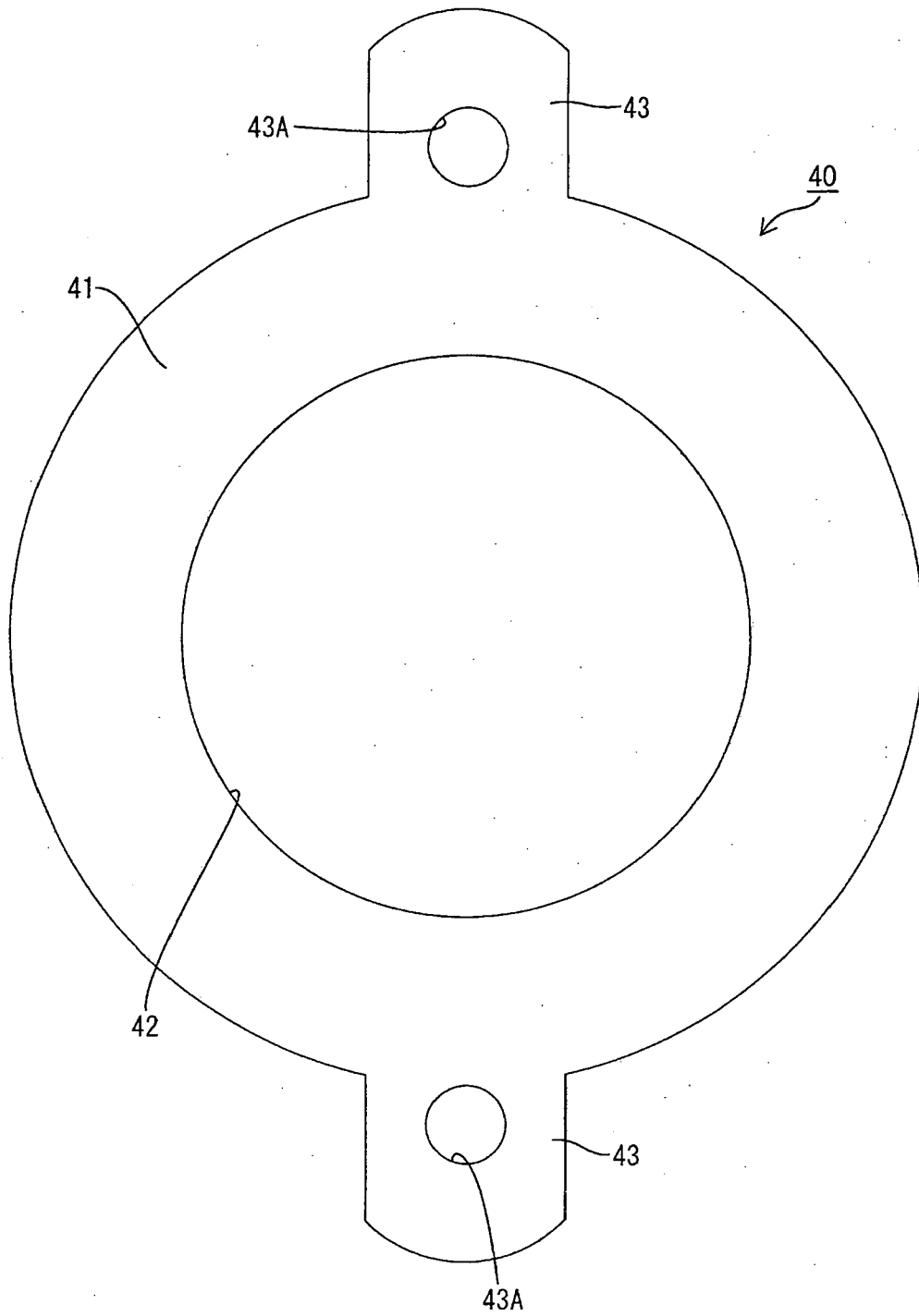


FIG. 6

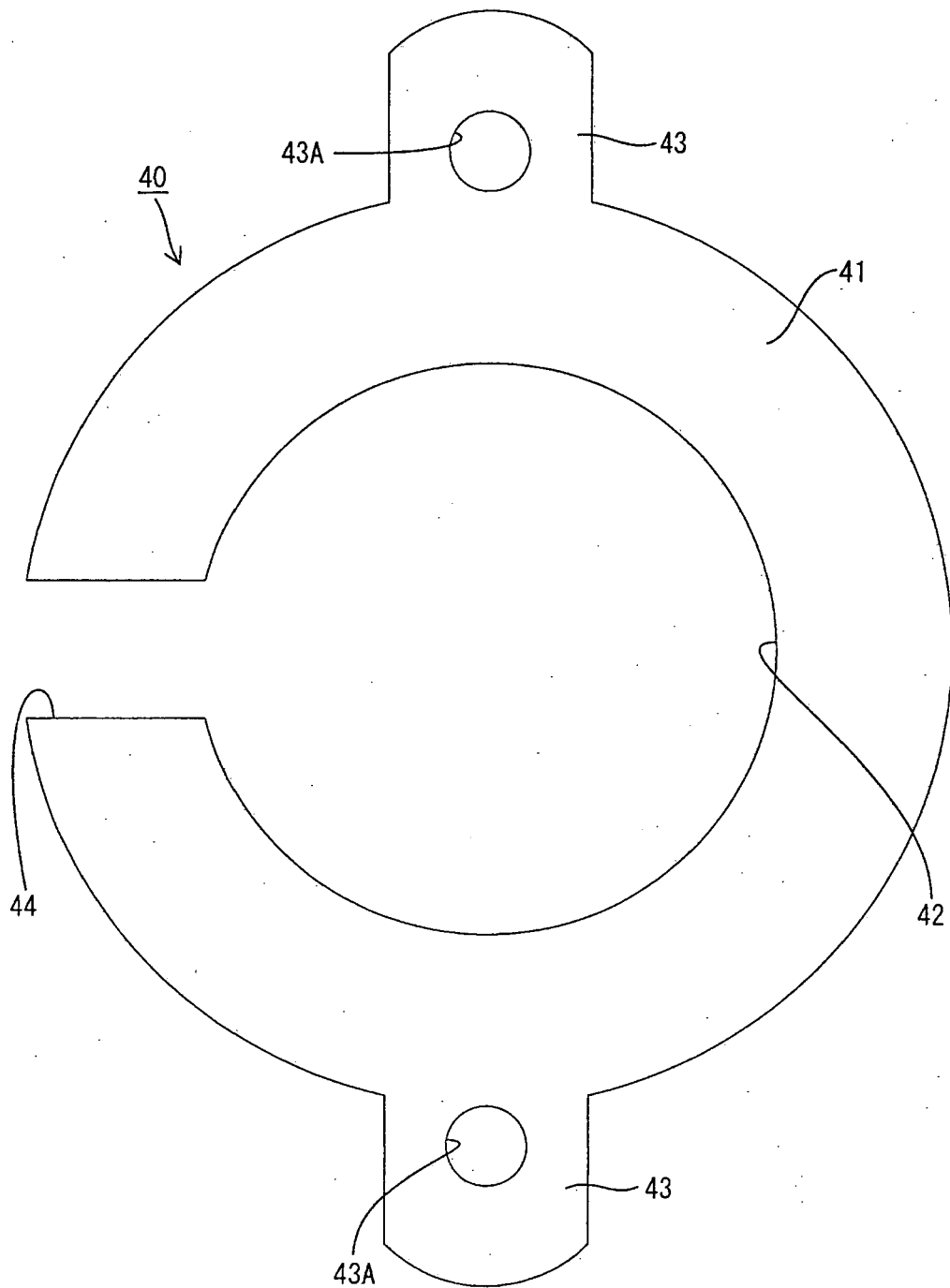


FIG. 7

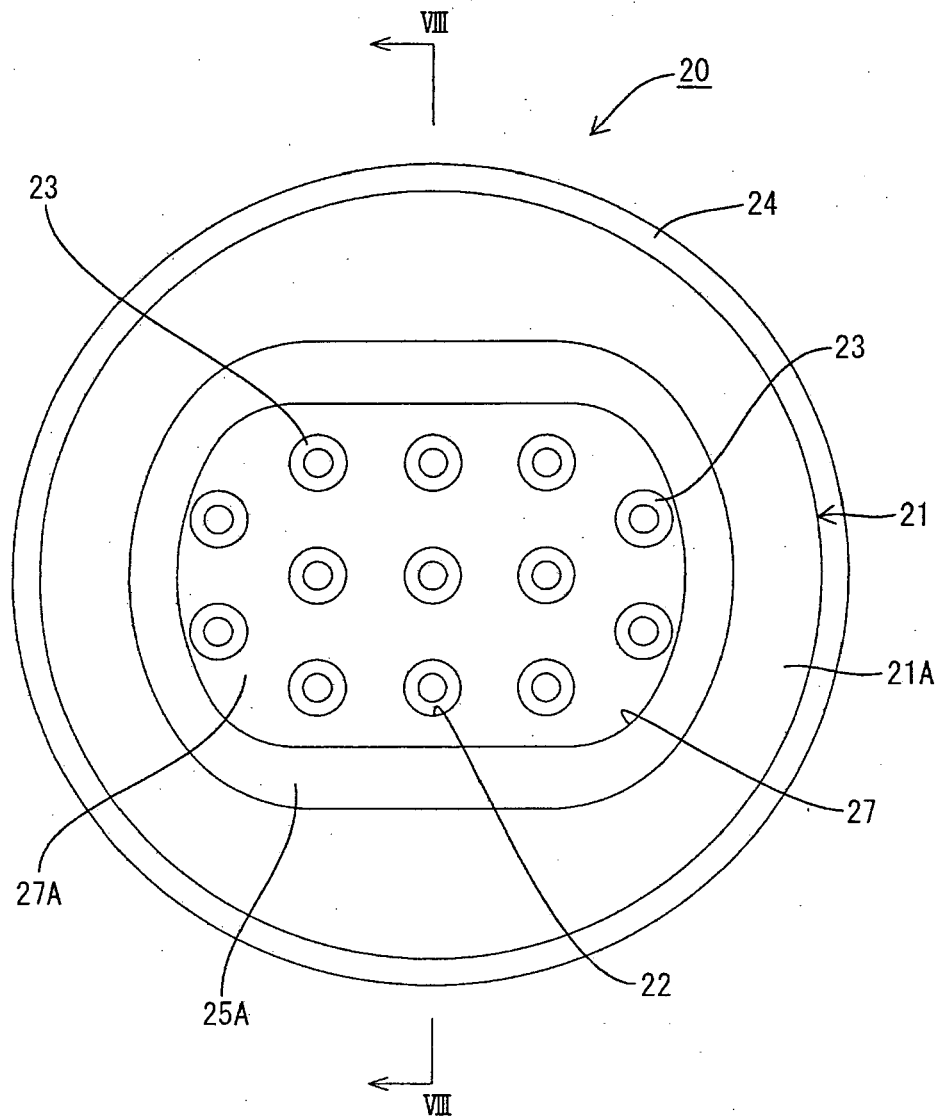


FIG. 8

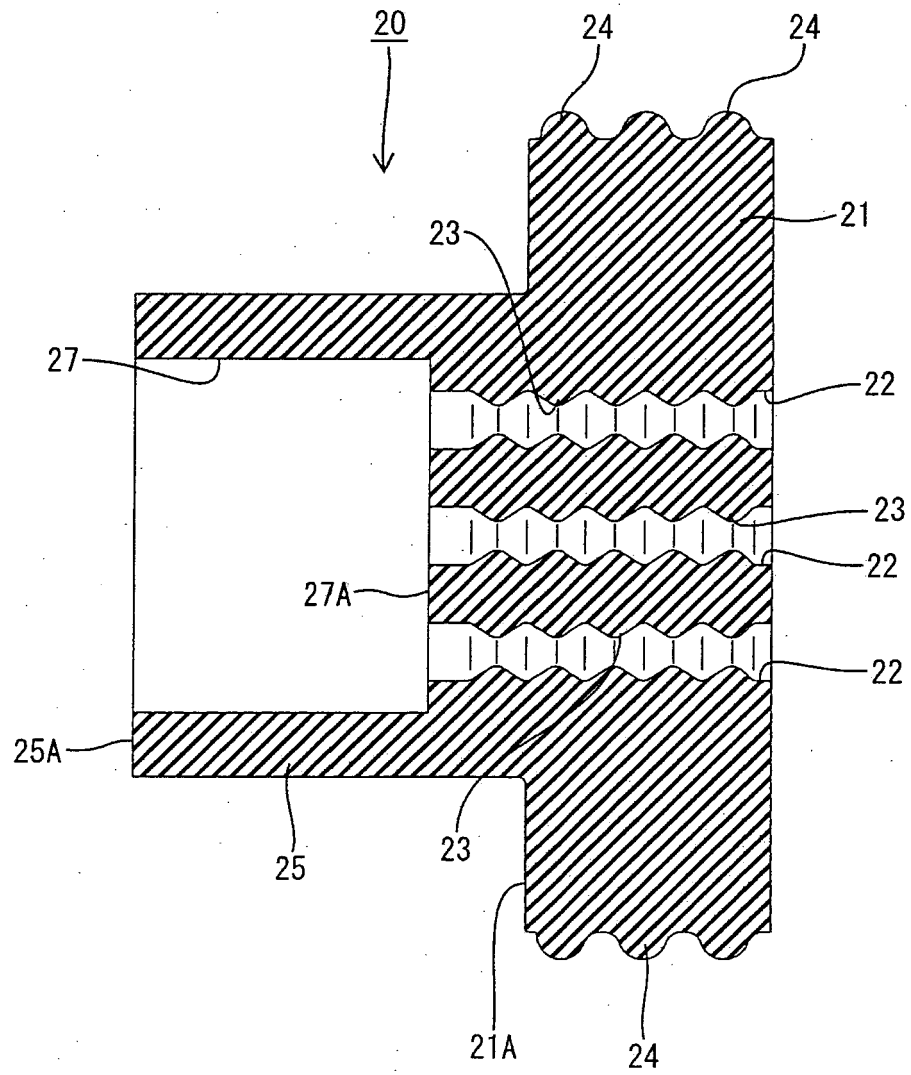


FIG. 9

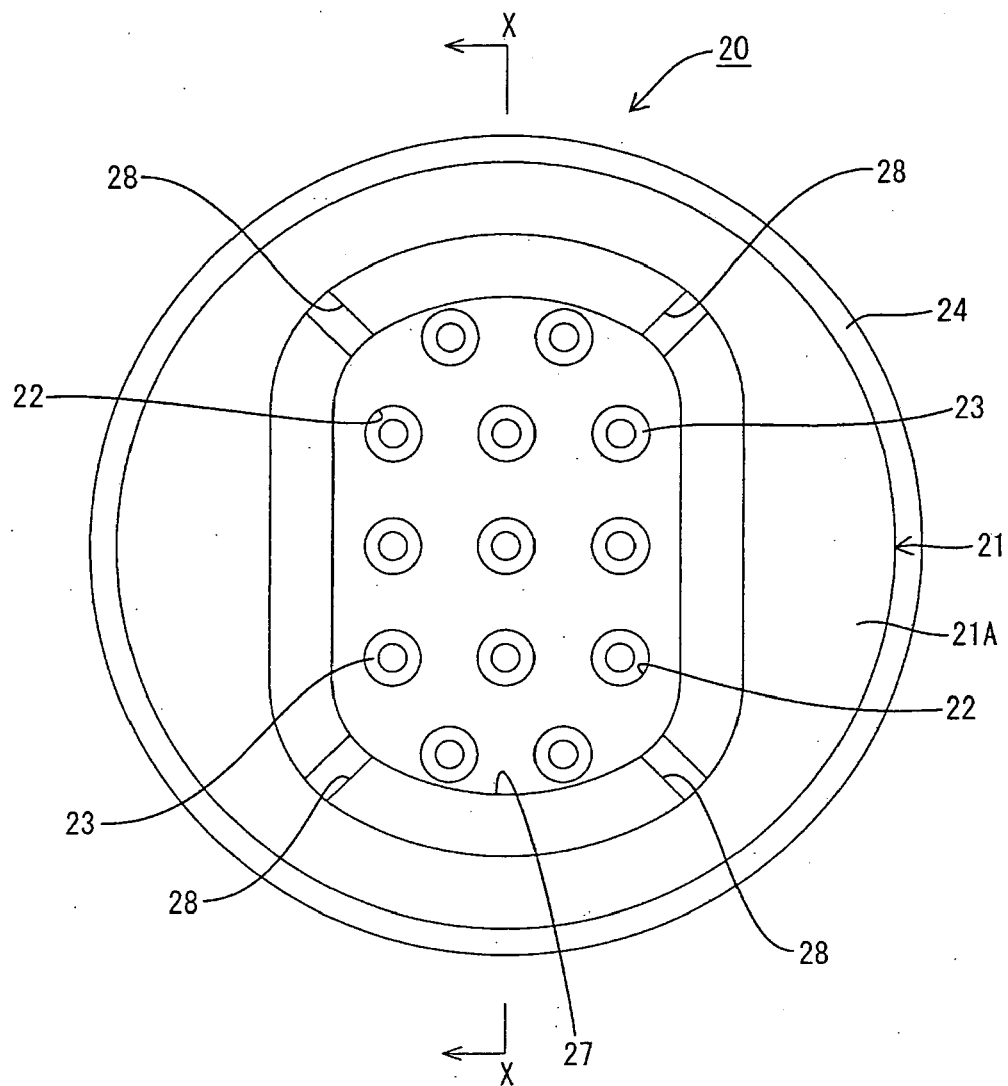
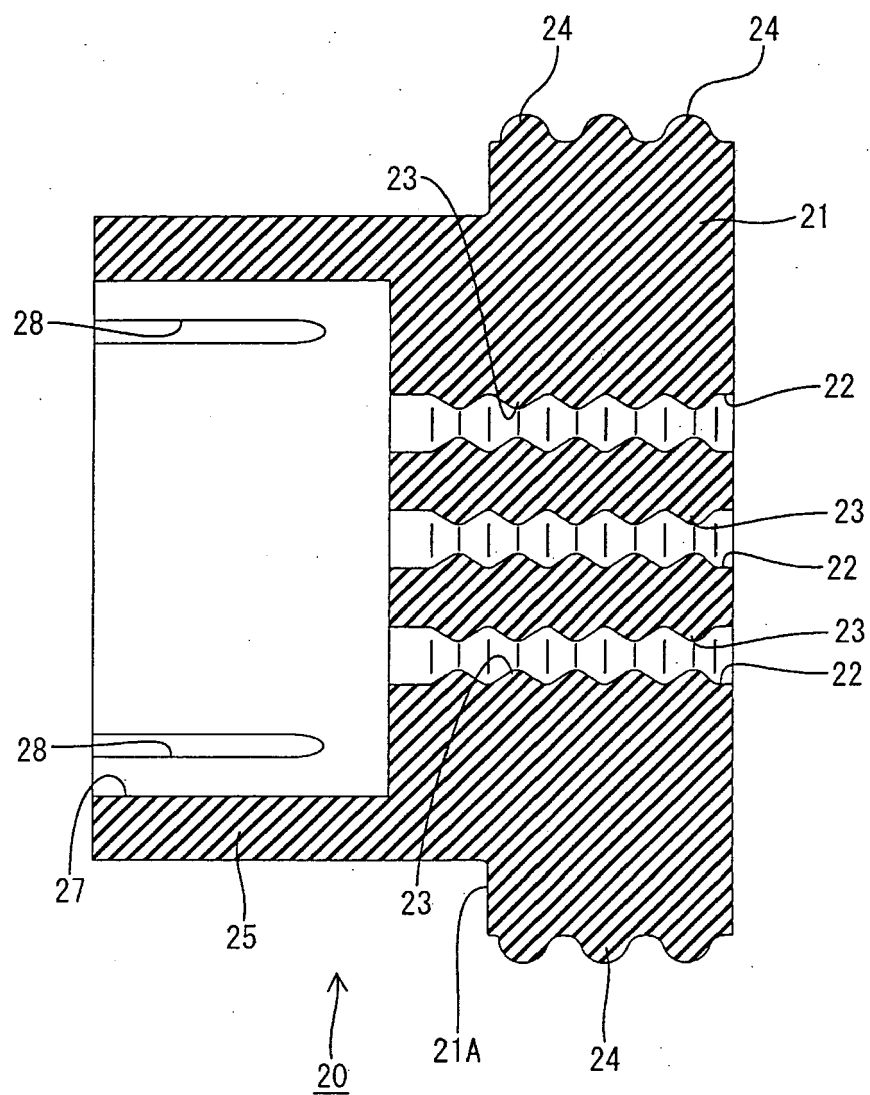


FIG. 10





EUROPEAN SEARCH REPORT

Application Number
EP 11 00 3487

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Y		5,13	
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Place of search The Hague		Date of completion of the search 29 June 2011	Examiner Popescu, Alexandru
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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